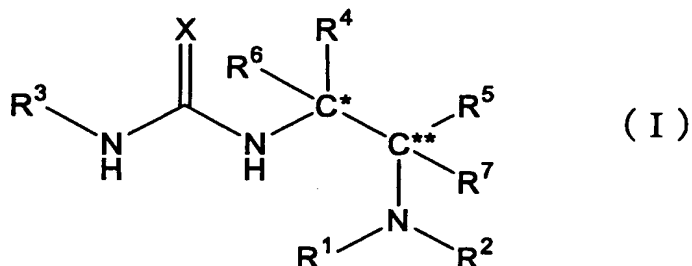


## Claims

1. A compound represented by the formula (I):



wherein

5 X is an oxygen atom or a sulfur atom;

C\* and C\*\* are each independently an asymmetric carbon;

 $R^1$  and  $R^2$  are

the same or different and each is a lower alkyl group

optionally having substituent(s), an aralkyl group

10 optionally having substituent(s) or an aryl group

optionally having substituent(s), or R<sup>1</sup> and R<sup>2</sup> optionally

form, together with the nitrogen atom they are bonded to,

an aliphatic heterocycle optionally having substituent(s)

(the aliphatic heterocycle is optionally condensed with an

15 aromatic hydrocarbon);

 $\mathbb{R}^3$  is

a lower alkyl group optionally having substituent(s), an

aralkyl group optionally having substituent(s), an aryl

group optionally having substituent(s) or a heteroaryl

20 group optionally having substituent(s);

 $R^4$  and  $R^5$  are

the same or different and each is a lower alkyl group

optionally having substituent(s), an aralkyl group

optionally having substituent(s) or an aryl group

25 optionally having substituent(s), or R<sup>4</sup> and R<sup>5</sup> optionally

form, together with the asymmetric carbons they are

respectively bonded to, a homocyclic ring optionally

having substituent(s) or a heterocycle optionally having

substituent(s); and

R<sup>6</sup> and R<sup>7</sup> are

the same or different and each is a hydrogen atom or a lower alkyl group optionally having substituent(s), or a salt thereof.

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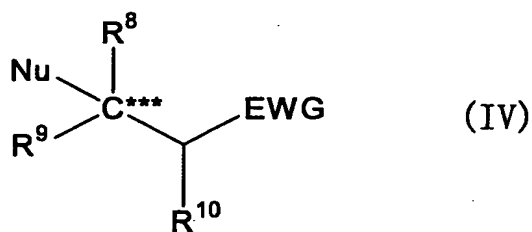
2. The compound of claim 1, wherein X is a sulfur atom, or a salt thereof.

3. The compound of claim 1 or 2, wherein R<sup>4</sup> and R<sup>5</sup> form,  
10 together with the asymmetric carbons they are respectively bonded to, cyclopropane, cyclobutane, cyclopentane or cyclohexane, or a salt thereof.

4. The compound of claim 3, wherein R<sup>4</sup> and R<sup>5</sup> form cyclohexane  
15 together with the asymmetric carbons they are respectively bonded to, and R<sup>6</sup> and R<sup>7</sup> are each a hydrogen atom, or a salt thereof.

5. The compound of claim 4, wherein the absolute configurations  
20 of C\* and C\*\* are both S-configurations or both R-configurations, or a salt thereof.

6. A method of producing a compound represented by the formula (IV):



wherein

C\*\*\* is an asymmetric carbon;

R<sup>8</sup>, R<sup>9</sup> and R<sup>10</sup> are

the same or different and each is a hydrogen atom, a lower  
30 alkyl group optionally having substituent(s), an aralkyl

group optionally having substituent(s), an aryl group optionally having substituent(s), a heteroaryl group optionally having substituent(s), a hetero atom optionally having substituent(s) or an electron withdrawing group, or  
5  $R^9$  and  $R^{10}$  optionally form, together with the carbon atoms they are respectively bonded to, a homocyclic ring optionally having substituent(s) or a heterocycle optionally having substituent(s), provided that  $R^8$  and  $R^9$  are not the same groups;

10 EWG is

an electron withdrawing group selected from a nitro group, a cyano group,  $-\text{COR}^{11}$ ,  $-\text{SO}_2\text{R}^{12}$ ,  $-\text{COOR}^{13}$  and  $-\text{PO}(\text{OR}^{14})(\text{OR}^{15})$

wherein

$R^{11}$ ,  $R^{12}$ ,  $R^{13}$ ,  $R^{14}$  and  $R^{15}$  are the same or different and  
15 each is a hydrogen atom, a lower alkyl group optionally having substituent(s), an aralkyl group optionally having substituent(s), an aryl group optionally having substituent(s) or a heteroaryl group optionally having substituent(s), or  $R^{11}$  and  $R^8$ , or  $R^{11}$   
20 and  $R^{10}$ , optionally form, together with the carbon atom(s) they are respectively bonded to, a homocyclic ring having an electron withdrawing group and optionally having substituent(s); and

Nu is

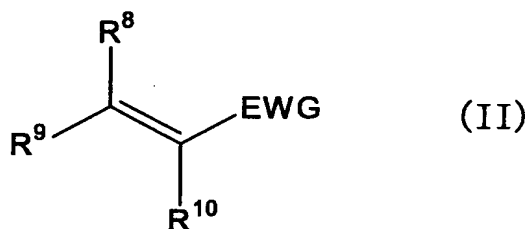
25  $-\text{CR}^{16}(\text{COR}^{17})(\text{COR}^{18})$ ,  $-\text{OR}^{19}$ ,  $-\text{SR}^{20}$ ,  $-\text{NR}^{21}\text{R}^{22}$ ,  $-\text{C}(\text{NO}_2)\text{R}^{23}\text{R}^{24}$

wherein

$R^{16}$  is a hydrogen atom, a halogen atom, a hetero atom having substituent(s), a lower alkyl group optionally having substituent(s) or an aryl group optionally  
30 having substituent(s);

$R^{17}$  and  $R^{18}$  are the same or different and each is a hydrogen atom, a lower alkyl group, a lower alkoxy group, a mono-lower alkylamino group or a di-lower alkylamino group;

$R^{16}$  and  $R^{17}$  optionally form, together with the carbon atoms they are respectively bonded to, a homocyclic ring optionally having substituent(s) or a heterocycle optionally having substituent(s) (the homocyclic ring and heterocycle are optionally condensed with an aromatic hydrocarbon); and  
 $R^{19}$ ,  $R^{20}$ ,  $R^{21}$ ,  $R^{22}$ ,  $R^{23}$  and  $R^{24}$  are the same or different and each is a hydrogen atom, a lower alkyl group optionally having substituent(s), an aralkyl group optionally having substituent(s), an aryl group optionally having substituent(s) or a heteroaryl group optionally having substituent(s), or  $R^{21}$  and  $R^{22}$  optionally form, together with the nitrogen atom they are bonded to, an aliphatic heterocycle optionally having substituent(s), or  
 an azido group,  
 or a salt thereof, which comprises conjugately adding a nucleophilic reagent represented by the formula (III): H-Nu (III) wherein Nu is as defined above, to a compound represented by the formula (II):



wherein each symbol is as defined above, or a salt thereof, in the presence of a compound or a salt thereof of any of claims 1 to 5.

25

7. The method of claim 6, wherein Nu is  $-CR^{16}(COR^{17})(COR^{18})$ ,  $-OR^{19}$ ,  $-SR^{20}$ ,  $-NR^{21}R^{22}$ ,  $-C(NO_2)R^{23}R^{24}$

wherein

$R^{16}$  is a hydrogen atom, a halogen atom, a lower alkyl group optionally having substituent(s) or an aryl group

30

optionally having substituent(s);

R<sup>17</sup> and R<sup>18</sup> are the same or different and each is a hydrogen atom, a lower alkyl group, a lower alkoxy group, a mono-lower alkylamino group or a di-lower alkylamino group;

5 R<sup>19</sup>, R<sup>20</sup>, R<sup>21</sup>, R<sup>22</sup>, R<sup>23</sup> and R<sup>24</sup> are the same or different and each is a hydrogen atom, a lower alkyl group optionally having substituent(s), an aralkyl group optionally having substituent(s), an aryl group optionally having substituent(s) or a heteroaryl group optionally having substituent(s), or R<sup>21</sup> and R<sup>22</sup> optionally form, together  
10 with the nitrogen atom they are bonded to, an aliphatic heterocycle optionally having substituent(s), or an azido group.

15 8. The method of claim 6 or 7, wherein the electron withdrawing group for EWG is a nitro group.

9. The method of any of claims 6 to 8, wherein R<sup>8</sup> and R<sup>10</sup> are each a hydrogen atom, and R<sup>9</sup> is a lower alkyl group optionally  
20 having substituent(s), an aryl group optionally having substituent(s) or a heteroaryl group optionally having substituent(s).

10. The method of any of claims 6 to 9, wherein the  
25 nucleophilic reagent (III) is represented by HCR<sup>16</sup>(COR<sup>17</sup>)(COR<sup>18</sup>) wherein each symbol is as defined above.

11. The method of claim 10, wherein R<sup>16</sup> is a hydrogen atom, a lower alkyl group optionally having substituent(s), a halogen  
30 atom or a hetero atom having substituent(s), and R<sup>17</sup> and R<sup>18</sup> are the same or different and each is a lower alkoxy group.

12. The method of claim 11, wherein R<sup>16</sup> is a hydrogen atom, methyl, a chlorine atom, methoxy or tert-butoxycarbonylamino,

and R<sup>17</sup> and R<sup>18</sup> are each methoxy or ethoxy.

13. The method of claim 10, wherein R<sup>16</sup> and R<sup>17</sup> optionally form,  
together with the carbon atoms they are respectively bonded to,  
5 a homocyclic ring optionally having substituent(s) (the  
homocyclic ring is optionally condensed with an aromatic  
hydrocarbon).

14. The method of claim 13, wherein the homocyclic ring is  
10 1,2,3,4-tetrahydronaphthalen-1-one.

15. The method of any of claims 6 to 14, which is performed in  
at least one solvent selected from toluene and methylene  
chloride.

15

16. The method of any of claims 6 to 14, which is performed  
without a solvent.